This key should allow you to understand why you choose the option you did (beyond just getting a question right or wrong). More instructions on how to use this key can be found here.

If you have a suggestion to make the keys better, please fill out the short survey here.

Note: This key is auto-generated and may contain issues and/or errors. The keys are reviewed after each exam to ensure grading is done accurately. If there are issues (like duplicate options), they are noted in the offline gradebook. The keys are a work-in-progress to give students as many resources to improve as possible.

---

1. Simplify the expression below into the form $a+bi$. Then, choose the intervals that a and b belong to.

$$\frac{72-66i}{-1+5i}$$

The solution is $-15.46-11.31i$, which is option D.

A. $a \in [-73, -71.5]$ and $b \in [-14.5, -12.5]$

$-72.00-13.20i$, which corresponds to just dividing the first term by the first term and the second by the second.

B. $a \in [-16.5, -15]$ and $b \in [-295, -293.5]$

$-15.46-294.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

C. $a \in [9, 11]$ and $b \in [16, 17.5]$

$9.92+16.38i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

D. $a \in [-16.5, -15]$ and $b \in [-11.5, -10.5]$

* $-15.46-11.31i$, which is the correct option.

E. $a \in [-402.5, -401]$ and $b \in [-11.5, -10.5]$

$-402.00-11.31i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

General Comment: Multiply the numerator and denominator by the *conjugate* of the denominator, then simplify. For example, if we have $2+3i$, the conjugate is $2-3i$.

---

2. Simplify the expression below and choose the interval the simplification is contained within.

$$17-14^2+5 \div 4 * 15 \div 13$$

The solution is -177.558, which is option A.

A. $[-177.68, -176.84]$

* -177.558, this is the correct option

B. $[-179.24, -177.84]$

-178.994, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

C. $[213.8, 215.01]$

214.442, which corresponds to an Order of Operations error: multiplying by negative before squaring. For example: $(-3)^2 \neq -3^2$

D. $[212.66, 214.13]$

213.006, which corresponds to two Order of Operations errors.

E. None of the above

You may have gotten this by making an unanticipated error. If you got a value that is not any of the others, please let the coordinator know so they can help you figure out what happened.

General Comment: While you may remember (or were taught) PEMDAS is done in order, it is actually done as P/E/MD/AS. When we are at MD or AS, we read left to right.

---

3. Choose the **smallest** set of Real numbers that the number below belongs to.

$$\sqrt{\frac{1980}{12}}$$

The solution is Irrational, which is option A.

A. Irrational

* This is the correct option!

B. Whole

These are the counting numbers with 0 (0, 1, 2, 3, ...)

C. Integer

These are the negative and positive counting numbers (..., -3, -2, -1, 0, 1, 2, 3, ...)

D. Not a Real number

These are Nonreal Complex numbers **OR** things that are not numbers (e.g., dividing by 0).

E. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3)

General Comment: First, you **NEED** to simplify the expression. This question simplifies to $\sqrt{165}$.

Be sure you look at the simplified fraction and not just the decimal expansion. Numbers such as 13, 17, and 19 provide **long but repeating/terminating decimal expansions!**

The only ways to *not* be a Real number are: dividing by 0 or taking the square root of a negative number.

Irrational numbers are more than just square root of 3: adding or subtracting values from square root of 3 is also irrational.

---

4. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\sqrt{\frac{-450}{10}}i + \sqrt{208}i$$

The solution is Nonreal Complex, which is option B.

A. Pure Imaginary

This is a Complex number $(a + bi)$ that **only** has an imaginary part like $2i$.

B. Nonreal Complex

* This is the correct option!

C. Irrational

These cannot be written as a fraction of Integers. Remember: π is not an Integer!

D. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3 + 5)

E. Not a Complex Number

This is not a number. The only non-Complex number we know is dividing by 0 as this is not a number!

General Comment: Be sure to simplify $i^2 = -1$. This may remove the imaginary portion for your number. If you are having trouble, you may want to look at the *Subgroups of the Real Numbers* section.

---

5. Simplify the expression below and choose the interval the simplification is contained within.

$$9 - 19 \div 15 * 4 - (6 * 14)$$

The solution is -80.067, which is option C.

A. $[-34.93, -23.93]$

-28.933, which corresponds to not distributing a negative correctly.

B. $[87.68, 98.68]$

92.683, which corresponds to not distributing addition and subtraction correctly.

C. $[-80.07, -76.07]$

* -80.067, which is the correct option.

D. $[-76.32, -71.32]$

-75.317, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

E. None of the above

You may have gotten this by making an unanticipated error. If you got a value that is not any of the others, please let the coordinator know so they can help you figure out what happened.

General Comment: While you may remember (or were taught) PEMDAS is done in order, it is actually done as P/E/MD/AS. When we are at MD or AS, we read left to right.

---

6. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$\frac{9 - 55i}{3 + 6i}$$

The solution is $-6.73 - 4.87i$, which is option A.

A. $a \in [-8, -6.5]$ and $b \in [-6, -4]$

* $-6.73 - 4.87i$, which is the correct option.

B. $a \in [-303.5, -302]$ and $b \in [-6, -4]$

$-303.00 - 4.87i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

C. $a \in [-8, -6.5]$ and $b \in [-220, -218.5]$

$-6.73 - 219.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

D. $a \in [7, 8.5]$ and $b \in [-3, -1.5]$

$7.93 - 2.47i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

E. $a \in [2, 4.5]$ and $b \in [-11.5, -8]$

$3.00 - 9.17i$, which corresponds to just dividing the first term by the first term and the second by the second.

General Comment: Multiply the numerator and denominator by the *conjugate* of the denominator, then simplify. For example, if we have $2 + 3i$, the conjugate is $2 - 3i$.

---

7. Choose the **smallest** set of Real numbers that the number below belongs to.

$$-\sqrt{\frac{180625}{625}}$$

The solution is Integer, which is option C.

A. Whole

These are the counting numbers with 0 (0, 1, 2, 3, ...)

B. Not a Real number

These are Nonreal Complex numbers **OR** things that are not numbers (e.g., dividing by 0).

C. Integer

* This is the correct option!

D. Irrational

These cannot be written as a fraction of Integers.

E. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3)

General Comment: First, you **NEED** to simplify the expression. This question simplifies to -425.

Be sure you look at the simplified fraction and not just the decimal expansion. Numbers such as 13, 17, and 19 provide **long but repeating/terminating decimal expansions!**

The only ways to *not* be a Real number are: dividing by 0 or taking the square root of a negative number.

Irrational numbers are more than just square root of 3: adding or subtracting values from square root of 3 is also irrational.

---

8. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$(7 - 4i)(10 + 9i)$$

The solution is $106 + 23i$, which is option D.

A. $a \in [30, 35]$ and $b \in [103, 105]$

$34 + 103i$, which corresponds to adding a minus sign in the first term.

B. $a \in [103, 112]$ and $b \in [-25, -19]$

$106 - 23i$, which corresponds to adding a minus sign in both terms.

C. $a \in [30, 35]$ and $b \in [-107, -101]$

$34 - 103i$, which corresponds to adding a minus sign in the second term.

D. $a \in [103, 112]$ and $b \in [19, 24]$

* $106 + 23i$, which is the correct option.

E. $a \in [68, 76]$ and $b \in [-36, -32]$

$70 - 36i$, which corresponds to just multiplying the real terms to get the real part of the solution and the coefficients in the complex terms to get the complex part.

General Comment: You can treat i as a variable and distribute. Just remember that $i^2 = -1$, so you can continue to reduce after you distribute.

---

9. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\sqrt{\frac{484}{289}} + 25i^2$$

The solution is Rational, which is option E.

A. Irrational

These cannot be written as a fraction of Integers. Remember: π is not an Integer!

B. Nonreal Complex

This is a Complex number $(a + bi)$ that is not Real (has i as part of the number).

C. Not a Complex Number

This is not a number. The only non-Complex number we know is dividing by 0 as this is not a number!

D. Pure Imaginary

This is a Complex number $(a + bi)$ that **only** has an imaginary part like $2i$.

E. Rational

* This is the correct option!

General Comment: Be sure to simplify $i^2 = -1$. This may remove the imaginary portion for your number. If you are having trouble, you may want to look at the *Subgroups of the Real Numbers* section.

---

10. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$(-5 - 3i)(-4 - 8i)$$

The solution is $-4 + 52i$, which is option C.

A. $a \in [38, 49]$ and $b \in [-33, -25]$

$44 - 28i$, which corresponds to adding a minus sign in the second term.

B. $a \in [38, 49]$ and $b \in [27, 29]$

$44 + 28i$, which corresponds to adding a minus sign in the first term.

C. $a \in [-4, 3]$ and $b \in [52, 54]$

* $-4 + 52i$, which is the correct option.

D. $a \in [-4, 3]$ and $b \in [-53, -50]$

$-4 - 52i$, which corresponds to adding a minus sign in both terms.

E. $a \in [19, 28]$ and $b \in [23, 26]$

$20 + 24i$, which corresponds to just multiplying the real terms to get the real part of the solution and the coefficients in the complex terms to get the complex part.

General Comment: You can treat i as a variable and distribute. Just remember that $i^2 = -1$, so you can continue to reduce after you distribute.
